

Kidney Disease of Diabetes

National Kidney and Urologic Diseases Information Clearinghouse



National
Institute of
Diabetes and
Digestive
and Kidney
Diseases

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Each year in the United States, more than 100,000 people are diagnosed with kidney failure, a serious condition in which the kidneys fail to rid the body of wastes. Kidney failure is the final stage of kidney disease, also known as nephropathy.

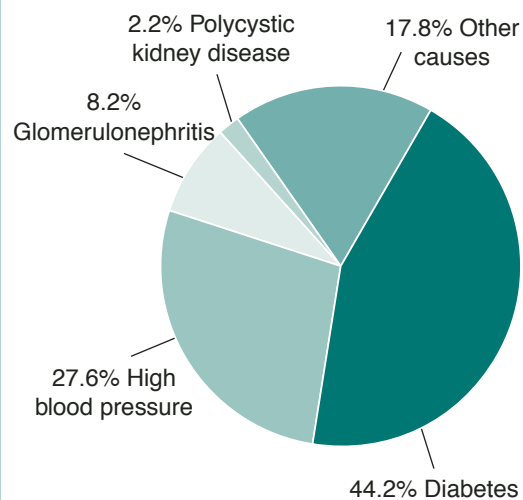
Diabetes is the most common cause of kidney failure, accounting for nearly 45 percent of new cases. Even when diabetes is controlled, the disease can lead to nephropathy and kidney failure. Most people with diabetes do not develop nephropathy that is severe enough to cause kidney failure. About 18 million people in the United States have diabetes, and more than 150,000 people are living with kidney failure as a result of diabetes.

People with kidney failure undergo either dialysis, which substitutes for some of the filtering functions of the kidneys, or transplantation to receive a healthy donor kidney. Most U.S. citizens who develop kidney failure are eligible for federally funded care. In 2003, care for patients with kidney failure cost the Nation more than \$27 billion.

African Americans, American Indians, and Hispanics/Latinos develop diabetes, nephropathy, and kidney failure at rates higher than Caucasians. Scientists have not been able to explain these higher rates.

Nor can they explain fully the interplay of factors leading to diabetic nephropathy—factors including heredity, diet, and other medical conditions, such as high blood pressure. They have found that high blood pressure and high levels of blood glucose increase the risk that a person with diabetes will progress to kidney failure.

**Primary Diagnoses (Causes)
for Kidney Failure (2003)**



U.S. Department
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Human Services

Two Types of Diabetes

There are two types of diabetes. In both types, the body does not properly process and use food. The human body normally converts food to glucose, the simple sugar that is the main source of energy for the body's cells. To enter cells, glucose needs the help of insulin, a hormone produced by the pancreas. When a person does not make enough insulin, or the body does not respond to the insulin that is present, the body cannot process glucose, and it builds up in the bloodstream. High levels of glucose in the blood lead to a diagnosis of diabetes. Both types of diabetes can lead to kidney disease.

Type 1 Diabetes

About 5 to 10 percent of people with diagnosed diabetes have type 1 diabetes, which tends to first occur in young adults and children. Type 1 used to be known as insulin-dependent diabetes mellitus or juvenile diabetes. In type 1 diabetes, the body stops producing insulin. People with type 1 diabetes must take daily insulin injections or use an insulin pump. They also control blood glucose levels with meal planning and physical activity. Type 1 diabetes is more likely to lead to kidney failure. Twenty to 40 percent of people with type 1 diabetes develop kidney failure by the age of 50. Some develop kidney failure before the age of 30.

Type 2 Diabetes

About 90 to 95 percent of people with diagnosed diabetes have type 2 diabetes, once known as noninsulin-dependent diabetes mellitus or adult-onset diabetes. Many people with type 2 diabetes do not respond normally to their own or to injected insulin—a condition called insulin resistance. Type 2 diabetes first occurs

more often in people over the age of 40, but it can occur at any age—even during childhood. Many people with type 2 are overweight. Many also are not aware that they have the disease. Some people with type 2 control their blood glucose with meal planning and physical activity. Others must take pills that stimulate production of insulin, reduce insulin resistance, decrease the liver's output of glucose, or slow absorption of carbohydrate from the gastrointestinal tract. Still others require injections of insulin in addition to pills.

The Course of Kidney Disease

Diabetic kidney disease takes many years to develop. In some people, the filtering function of the kidneys is actually higher than normal in the first few years of their diabetes. This process has been called hyperfiltration.

Over several years, people who are developing kidney disease will have small amounts of the blood protein albumin begin to leak into their urine. At its first stage, this condition has been called microalbuminuria. The kidney's filtration function usually remains normal during this period.

As the disease progresses, more albumin leaks into the urine. This stage may be called overt diabetic nephropathy or macroalbuminuria. As the amount of albumin in the urine increases, filtering function usually begins to drop. The body retains various wastes as filtration falls. Creatinine is one such waste, and a blood test for creatinine can be used to estimate the decline in kidney filtration. As kidney damage develops, blood pressure often rises as well.

Overall, kidney damage rarely occurs in the first 10 years of diabetes, and usually 15 to 25 years will pass before kidney failure occurs. For people who live with diabetes for more than 25 years without any signs of kidney failure, the risk of ever developing it decreases.

Effects of High Blood Pressure

High blood pressure, or hypertension, is a major factor in the development of kidney problems in people with diabetes. Both a family history of hypertension and the presence of hypertension appear to increase chances of developing kidney disease. Hypertension also accelerates the progress of kidney disease when it already exists.

In the past, hypertension was defined as blood pressure exceeding 140 millimeters of mercury-systolic and 90 millimeters of mercury-diastolic. Professionals shorten the name of this limit to 140/90 or “140 over 90.” The terms systolic and diastolic refer to pressure in the arteries during contraction of the heart (systolic) and between heartbeats (diastolic).

The American Diabetes Association and the National Heart, Lung, and Blood Institute recommend that people with diabetes keep their blood pressure below 130/80.

Hypertension can be seen not only as a cause of kidney disease, but also as a result of damage created by the disease. As kidney disease proceeds, physical changes in the kidneys lead to increased blood pressure. Therefore, a dangerous spiral, involving rising blood pressure and factors that raise blood pressure, occurs. Early detection and treatment of even mild hypertension are essential for people with diabetes.

Preventing and Slowing Kidney Disease

Blood Pressure Medicines

Scientists have made great progress in developing methods that slow the onset and progression of kidney disease in people with diabetes. Drugs used to lower blood pressure (antihypertensive drugs) can slow the progression of kidney disease significantly. Two types of drugs, angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs), have proven effective in slowing the progression of kidney disease. Many people require two or more drugs to control their blood pressure. In addition to an ACE inhibitor or an ARB, a diuretic is very useful. Beta blockers, calcium channel blockers, and other blood pressure drugs may also be needed.

An example of an effective ACE inhibitor is captopril, which doctors commonly prescribe for treating kidney disease of diabetes. The benefits of captopril extend beyond its ability to lower blood pressure: it may directly protect the kidney's glomeruli. ACE inhibitors have lowered proteinuria and slowed deterioration even in diabetic patients who did not have high blood pressure.

An example of an effective ARB is losartan, which has also been shown to protect kidney function and lower the risk of cardiovascular events.

Any medicine that helps patients achieve a blood pressure target of 130/80 or lower provides benefits. Patients with even mild hypertension or persistent microalbuminuria should consult a physician about the use of antihypertensive medicines.

Moderate-Protein Diets

In people with diabetes, excessive consumption of protein may be harmful. Experts recommend that people with kidney disease of diabetes consume the recommended dietary allowance for protein, but avoid high-protein diets. For people with greatly reduced kidney function, a diet containing reduced amounts of protein may help delay the onset of kidney failure. Anyone following a reduced-protein diet should work with a dietitian to ensure adequate nutrition.

Intensive Management of Blood Glucose

Antihypertensive drugs and low-protein diets can slow kidney disease when significant nephropathy is present. A third treatment, known as intensive management of blood glucose or glycemic control, has shown great promise for people with type 1 and type 2 diabetes, especially for those in early stages of nephropathy.

Intensive management is a treatment regimen that aims to keep blood glucose levels close to normal. The regimen includes testing blood glucose frequently, administering insulin frequently throughout the day on the basis of food intake and physical activity, following a diet and activity plan, and consulting a health care team frequently. Some people use an insulin pump to supply insulin throughout the day.

A number of studies have pointed to the beneficial effects of intensive management. In the Diabetes Control and Complications Trial (DCCT) supported by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), researchers found a 50 percent decrease in both development and progression of early diabetic kidney disease in participants who followed an intensive regimen for controlling blood

glucose levels. The intensively managed patients had average blood glucose levels of 150 milligrams per deciliter—about 80 milligrams per deciliter lower than the levels observed in the conventionally managed patients. The United Kingdom Prospective Diabetes Study, conducted from 1976 to 1997, showed conclusively that, in people with improved blood glucose control, the risk of early kidney disease was reduced by a third. Additional studies conducted over the past decades have clearly established that any program resulting in sustained lowering of blood glucose levels will be beneficial to patients in the early stages of diabetic nephropathy.

Dialysis and Transplantation

When people with diabetes experience kidney failure, they must undergo either dialysis or a kidney transplant. As recently as the 1970s, medical experts commonly excluded people with diabetes from dialysis and transplantation, in part because the experts felt damage caused by diabetes would offset benefits of the treatments. Today, because of better control of diabetes and improved rates of survival following treatment, doctors do not hesitate to offer dialysis and kidney transplantation to people with diabetes.

Currently, the survival of kidneys transplanted into patients with diabetes is about the same as survival of transplants in people without diabetes. Dialysis for people with diabetes also works well in the short run. Even so, people with diabetes who receive transplants or dialysis experience higher morbidity and mortality because of coexisting complications of the diabetes—such as damage to the heart, eyes, and nerves.

Good Care Makes a Difference

If you have diabetes:

- Have your doctor measure your A1C level at least twice a year. The test provides a weighted average of your blood glucose level for the previous 3 months. Aim to keep it at less than 7 percent.
- Work with your doctor regarding insulin injections, medicines, meal planning, physical activity, and blood glucose monitoring.
- Have your blood pressure checked several times a year. If blood pressure is high, follow your doctor's plan for keeping it near normal levels. Aim to keep it at less than 130/80.
- Ask your doctor whether you might benefit from taking an ACE inhibitor or ARB.
- Have your urine checked yearly for microalbumin and protein.
- Have your blood checked for elevated amounts of waste products such as creatinine. The doctor should provide you with an estimate of your kidney's filtration based on the blood creatinine level.
- Ask your doctor whether you should reduce the amount of protein in your diet. Ask for a referral to see a registered dietitian to help you with meal planning.

Hope Through Research

The incidences of both diabetes and kidney failure caused by diabetes have been rising. Some experts predict that diabetes soon might account for half the cases of kidney failure. In light of the increasing morbidity and mortality related to diabetes and kidney failure, patients, researchers, and health care professionals will continue to benefit by addressing the relationship between the two diseases. NIDDK is a leader in supporting research in this area.

Several areas of research supported by NIDDK hold great potential. Discovery of ways to predict who will develop kidney disease may lead to greater prevention, as people with diabetes who learn they are at risk institute strategies such as intensive management and blood pressure control. Discovery of better anti-rejection drugs will improve results of kidney transplantation in patients with diabetes who develop kidney failure. For some people with type 1 diabetes, advances in transplantation—especially transplantation of insulin-producing cells of the pancreas—could lead to a cure for both diabetes and the kidney disease of diabetes.

For More Information

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National Kidney and Urologic Diseases Information Clearinghouse

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The National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1987, the Clearinghouse provides information about diseases of the kidneys and urologic system to people with kidney and urologic disorders and to their families, health care professionals, and the public. The NKUDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about kidney and urologic diseases.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts.

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